

ON SOME AMERICAN AND ORIENTAL EARTHWORMS

PART I

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This article contains descriptions and notes on distributions of earthworms sent recently to the Zoology department of Ohio State University for identification. Included among this material is the first specimen of the large Indian earthworm, *Drawida grandis* (Bourne) 1886, that has been available for study since the species was first described; the first specimens of *Drawida* from the type locality of *D. barwelli* (Beddard) 1886 that have been examined since the erection of that species; several specimens of one or possibly two species of the little known Philippine genus *Plionogaster* and material belonging to new species of five Moniligastrid or Megascolecoid genera, including five new species from the United States. Although specific identification of the *Plionogaster*s is at present impossible, study of this material has enabled recognition of the nature of the excretory system which is of a mixed type with both meganephric and micronephric tubules, the meganephridia enteronephric and resembling those in *Lampito*.

In connection with the section on *Diplocardia*, attention is once again (*vide* Gates 1929*a* and *b*) directed to the fact that much work, even of the most elementary nature remains to be done on the earthworms of the United States. Very little is known of the earthworms in that portion of the country below the southern limit of glaciation where native species are most to be expected. It may be permissible to express a hope that if war, inflation or high taxation prevent continued organization of costly expeditions to distant tropic and arctic regions, American zoologists will turn their attention to their own front yards, for instance to Alabama, South Carolina, Tennessee, Kentucky, Virginia, Arkansas, Oklahoma and Kansas with no records of *Diplocardia* hitherto, Mississippi and Texas with one record each hitherto, Georgia with two records, North Carolina with four records. Even in those northern states where some work on distribution has been done (Illinois, Indiana and Ohio), the gross morphology of the earliest named species is so inadequately characterized that recognition of intrageneric relationships is difficult or impossible. Attention of those in museums and biological surveys is also directed to the fact that types of nine or ten of the few known endemics are in European museums, that types of other endemics were probably destroyed in the San Francisco earthquake, and that the location and condition of other types is unknown. With possibility of further destruction of types during the war and to provide reference material for local workers, series from all of the type localities should be collected at the earliest opportunity.

The writer is indebted to Prof. R. C. Osburn for the privileges of the Zoology department during the academic year 1940-41, and to Prof. W. M. Barrows for the collection and careful preservation of the Florida forms.

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Family MONILIGASTRIDAE

Genus DRAWIDA Michaelsen 1900

Drawida bournei (Michaelsen) 1897

Material examined.—Slides from the U. S. Nat. Mus. with sagittal sections of a half portion of an anterior end of a specimen, presumably from Ceylon, presented to Prof. Frank Smith by Dr. W. Michaelsen.

Internal anatomy.—Gizzards appear to be in xv-xviii. Recognition of boundaries of the male funnel is difficult but the testes appear to be attached to an anterior portion of the funnel which is located immediately above the region of attachment to the testis sac of septum 9/10. The vas deferens is certainly looped in front of 9/10 (probably also behind 9/10) and passes into the anterior face of the prostate without first passing into the parietes. The prostate is a longitudinally ellipsoidal body sessile on the parietes. The spermathecal duct is slightly thickened in the parietes, the widened portion ovoidal with narrower end ectally. The oviducal funnel is continued dorsally on the septum to a point just above the aperture into the ovisac.

Remarks.—*D. bournei* is one of a group of forms with "muscular" prostates. The taxonomic status of each of these species except *D. grandis* is still unsettled. It is very doubtful if information of much importance in connection with these problems can be obtained from sections such as those of *D. bournei*. After study of that material and of sections of *Syngenorhilus lamuensis* Smith & Green 1919 and of the literature on other species known only from similarly prepared sections as well as of sections prepared by professional technicians the author is of the opinion that Stephenson (1923, p. 6) was quite correct as to the advisability of dissection in the study of unique types and limited series.

Drawida grandis (Bourne) 1886

Material examined.—Valley above dhobi quarter, 300 feet above town towards Government House, by dam, Ootacamund, South India, November 15, 1932, 1 anterior fragment (ca. 180 mm. long). G. E. Hutchinson per Dr. Grace Pickford.

External characteristics.—Diameter 11 mm. Pigment unrecognizable. Prostomium probolous, segment i partially retracted into ii. Nephropores begin on iii, those of vii-ix slightly displaced dorsally, posteriorly in *cd*, not displaced on xii, apparently functional on x. Clitellar coloration unrecognizable. Setae are closely paired, *ab* and *cd* about equal, *aa* < *bc*. On viii the setae are one mm. from 7/8 and 4½ mm. from 8/9. Setae are located on the anterior halves of the segments throughout all of the fragment.

The spermathecal pore of one side is a transversely placed slit on 7/8 on *c*, with protuberant wrinkled margins. On the other side the pore is on the ventral face of a rather conical protuberance. The female pores are on 11/12, about on *b*. The male pores are transversely placed slits just lateral to *b*. No genital markings.

Internal anatomy.—Septa 5/6-8/9 are thickly muscular. Gizzards are in xix-xxiii, but with strongly marked muscularity of the oesophagus in xvii and xviii. The postgizzard portion of the oesophagus is bent into a U-shape with the concavity facing the left side, the inner wall provided with high vertical ridges crossed by longitudinal furrows. The intestine begins in xxxiv. No typhlosole.

The last pair of hearts is in ix. Paired commissures are present on the posterior faces of 8/9-9/10. The extra-oesophageals are lateral to the hearts. Nephridia are present in x.

The left testis sac is displaced behind the ovarian segment. The vas deferens is in a number of fairly long hairpin loops on the anterior face of 9/10 and more closely compacted, shorter loops on the posterior face but the total mass of the loops is much smaller than that of the testis sac. The ectal portion is iridescent and passes into the median face of the prostate close to the parietes. The prostate is disc-shaped, of circular outline, about 2½ mm. in diameter, sessile on the parietes, the duct slightly and gradually narrowed ectally within the

parietes, the greatest thickness more than half that of the prostate. The lumen of the prostate is a narrowly slit-like, horizontal cavity, the roof with three irregular ridges. On the center of the floor there is a tiny slit the margins of which are wrinkled, this portion possibly capable of protrusion through the male aperture as a sort of penis.

The spermathecal duct passes into the septum fairly high up in viii and deep in the parietes is slightly thickened, the atrial portion rather elongately top-shaped. The lumen of the duct remains narrow but has an irregular course through the greater portion of the length of the atrium, in the ectalmost portion abruptly widened and with irregular walls. In this portion there is a tiny conical protuberance. Segment xi is reduced to a horseshoe-shaped ovarian chamber. Ovisacs extend into xii or xiv.

Remarks.—Ovisacs are contracted, with thick walls, the lumen filled with a felted, dark brown material. There are no free ova in the ovarian chamber. Spermathecal ampullae are distended. The worm is probably in a late postsexual stage.

Drawida sp. 1

Material examined.—Valley above dhobi quarter, 300 feet above town towards Government House, by dam, Ootacamund, South India, November 15, 1932, 1 mature specimen. G. E. Hutchinson per Dr. Grace Pickford.

External characteristics.—Length 132 mm. Diameter 6 mm. Pigment unrecognizable. Prostomium probolous, retracted under iii. Nephropores begin on iii, those of viii slightly displaced dorsally, not displaced on xii, apparently functional on x. Clitellar coloration unrecognizable. The setae are paired, *ab* and *cd* about equal, *aa* and *bc* about equal.

The spermathecal pores are transversely placed slits, not minute, on 7/8 in *cd*. Female pores are on the anteriormost margin of xii just lateral to *b*. Male pores are transversely placed slits on 10/11 just lateral to the seminal grooves and hence in the lateral half of *bc*. The grooves are longitudinally placed, rather irregular, clearly marked and fairly deep with slightly tumescent margins, extending across almost all of x and to the setal arc of xi, crossing 10/11 about at mid *bc*. No genital markings.

Internal anatomy.—Septa 5/6-8/9 are thickly muscular. Gizzards are in xvi-xxi, the one in xvi small. The intestine begins in the region of xxxi-xxxiii. Enterosegmental organs are present. No typhlosole.

The last pair of hearts is in ix. There is a pair of commissures on the anterior face of 8/9. Extraoesophageal trunks are lateral to the hearts. Nephridia are present in x.

The right testis sac is dislocated posteriorly, the left sac approximately equally in ix and x. The vas deferens is fairly long and looped on both sides of 9/10 but the mass of the loops is much less than that of the testis sac. No slender portion noted. The vas passes directly into the anterior face of the prostate near the ental end without first passing into the parietes. The prostates are rather ovoidal but with bluntly rounded ends, the ectal end broader, protuberant into the coelomic cavity to a height of two mm., leaning slightly mesially, the duct restricted to the parietes and on the median side of the ventral face of the gland. The glandular portion (coelomic) is in the form of a crescentic to U-shaped band of pink, coarsely granular appearance placed transversely across the prostate, reaching mesially and laterally nearly to the parietes, the anterior and posterior faces of the prostatic capsule smooth and bare. Internally the prostate is lined with a slightly pink, soft layer. The cavity is closed off ventrally and is eccentric due to the greater thickness of the floor. Into the transversely slit-like cavity within the body wall there is protuberant a rather indefinite, roughly conical but wrinkled bit of tissue, possibly a penis protrusible to the exterior through the male pore.

The spermathecal atrium is thickwalled, rather conical but with bluntly rounded dorsal surface, protuberant into the coelomic cavity of viii, directed posteriorly, smaller than the prostates. The spermathecal duct passes into the median face of the atrium somewhat below the ental end. The lumen is U-shaped in horizontal section due to the presence on the anterior wall of a vertical ridge. The ovarian segment is reduced to a horseshoe-shaped chamber. Ovisacs extend into xv.

Remarks.—Ovisacs are distended, yellowish and filled with ova but there are only a few loose ova in the ovarian chamber. Spermathecal ampullae are distended. Deferent ducts are slightly iridescent. The worm appears to have passed the peak of sexual activity.

Distinguished from *D. matthai* Michaelsen 1910 and *sulcata* Michaelsen 1907, the other species of the genus with seminal grooves, by characteristics of prostates and spermathecal atria of sufficient importance to warrant erection of a new species. The single specimen has been dissected too drastically to be of value as a type.

Drawida sp. 2

Material examined.—Manila, Philippine Islands, October, 3 juvenile specimens.

Zacharias de Jesus per Prof. R. C. Osburn.

External characteristics.—Length to 75 mm. Diameter to $2\frac{1}{2}$ mm. Unpigmented. Prostomium prolobous. Nephropores posterior to xii, when recognizable, are in *cd*, on viii slightly dorsal to *d*, still less so on vii and anteriorly, not seen on ix-xii. Setae begin on ii but are partly lacking as far back as x; on xx, $ab=cd$, $aa<bc$, $dd\ ca.=\frac{1}{2}C$ but slightly greater posteriorly.

The spermathecal pores are transversely placed slits with slightly wrinkled margins on 7/8, on or just median to *c*. Female pores are on *b*, just behind 11/12. Male pores are transversely placed slits about in line with 10/11 on the ventral ends of conspicuously protuberant, columnar porophores seated across 10/11, slightly nearer to *c* than to *b*, the porophores not distinctly demarcated laterally and mesially but apparently reaching nearly to *b* and *c*, sharply demarcated anteriorly and posteriorly by transverse furrows, the portion belonging to xi probably slightly larger than that belonging to x.

Genital markings are a pair of longitudinally placed areas of elliptical outline and epidermal thickening, sharply demarcated, in the lateral half of *bc* on x, reaching anteroposteriorly nearly to 9/10 and 10/11. In addition there is just anterior and posterior to each male porophore a slightly depressed, indistinctly demarcated area of greyish translucence or especially homogeneous opacity.

Internal anatomy.—Septa 5/6–8/9 are thickly muscular. Gizzards are in xii-xiv (1), xiv-xvii (1), xv-xvii (1). The intestine begins in xxvi (1), xxvii (1), xxviii (1). No typhlosole.

The last pair of hearts is in ix (3). There are paired, vertical commissures on the posterior faces of 8/9 and 9/10. Extra-oesophageal trunks are lateral to the hearts. Nephridia are on the posterior faces of the septa and reach up to the dorsal blood vessel. Preseptal funnels are close to the ventral parietes in the region of *ab*. Nephridia apparently are lacking in x.

The testis sacs are constricted by 9/10 with approximately equal portions in ix and x. The vas deferens is very short, without loops in ix where it passes around the heart, with several loose hairpin loops in x, passing directly into the anteromedian aspect of the prostate slightly above the parietes without first passing into the body wall (3). The prostates are sessile on the parietes, the capsule whitish, top-shaped, an almost spheroidal portion sessile on the body wall, an antero-posteriorly flattened duct within the parietes. The lumen is transversely slit-like in horizontal section. The prostates may be slightly bent over mesially or anteromesially.

Segment xi is reduced to a horseshoe-shaped ovarian chamber (2 largest specimens). Ovisacs, even in the largest worm, are juvenile. There are no spermathecal atria nor is there any recognizable enlargement of the duct within the parietes.

Remarks.—Testis sacs are well developed in all three specimens. In the smallest worm the spermathecal ampullae are just recognizable as slight widenings of the ental ends of the spermathecal ducts, and ovisacs do not reach across xii. In the other worms the spermathecal ampullae are filled with whitish material but the ovisacs which extend into xiv are still juvenile. The vas deferens is of about the same length in all three specimens. Except for the ovisacs sex organs appear to be fully developed.

Manila is the type locality of *D. barwelli* (Beddard) 1886 but little of taxonomic value is known of that species (*vide* Gates 1937).

Genus DESMOGASTER Rosa 1890

Desmogaster ferina sp. nov.

Material examined.—Beneath brookside log, Tingpai, Myitkyina district, Burma, November, 1 juvenile and 1 larger, possibly fully grown specimen. F. D. Forbes.

External characteristics.—Length 137–171 mm. Diameter 4–5 mm. Unpigmented. Each specimen is coiled in a rather spiral fashion and is dorsoventrally flattened except for a short anterior region. Prostomium probolous. Secondary annulation begins on v (2), one deep, presetal secondary furrow present on each of segments v–xii.

Setae are lacking on the anteriormost segments, beginning on ix on the smaller specimen where only *c* and *d* of the left side are lacking, on x of the larger worm where both couples of the left side are lacking, and are small, closely paired, *ab* and *cd* about equal, *aa* much larger than *bc*, *dd* probably slightly greater than $\frac{1}{2}C$. On one or two segments anterior to x or ix a transversely placed, greyish translucent line at the approximate sites of the ventral couples is visible.

Nephropores, when visible, are on the anterior margins of the segments, in *bc*, the location variable, nearer *b*, at mid *bc*, or nearer to *c*.

Bithecal, the spermathecal apertures represented, on the larger specimen, by minute, circular pores on 8/9, about on *c*. The male pores are small, transversely placed slits on 11/12 and 12/13, slightly median to *c*. Female apertures are transversely placed slits on xiv, quite definitely behind 13/14 and slightly lateral to *b*.

Internal anatomy.—Septa 5/6–9/10 are thickly muscular, funnel-shaped, apices directed posteriorly.

Gizzards are six in xx–xxv or seven in xx–xxvi.

Extra-oesophageal trunks are first recognizable in v from whence they pass posteriorly just lateral to the hearts and into the subneural vessel in xvi. Anterior to this junction the subneural is very slender and recognizable for only a short distance. On the posterior faces of 10/11 and 11/12 there are commissures from the extra-oesophageal trunks to the dorsal vessel. The last pair of hearts is in xi (2). Hearts or heartlike commissures are present in v–x but those of v–vii have not been traced to the ventral trunk.

Nephridia are present from iv posteriorly, the ducts, in the postgenital segments at least, passing into the parietes just behind the septa in the region of *ab*.

Paired testis sacs are present in the usual locations, in 10/11 and 11/12. The vas deferens is short, and drops directly, without any real looping, to the ventral parietes into which it enters just behind the septum, in *ab*. The prostates are bent over mesially or medioposteriorly in xi and xii, elliptical in cross section, about two mm. long (in the larger worm), the ental end bluntly rounded. In cross sections two canals are visible, one central or nearly so and slitlike to shortly elliptical, the other much smaller, eccentric and more nearly circular.

Segment xiii is reduced to a horseshoe-shaped ovarian chamber (2). The right ovisac of the larger worm is lateromesially flattened and reaches into xx. The spermathecal ampullae are fairly large, flattened discs, about $1\frac{1}{2}$ mm. in diameter, with heart-shaped outline, on the posterior face of 8/9, the entalmost portion of the duct located in the ventral notch very slightly thickened. Underneath the ampulla the duct is in several hairpin loops, an ectal portion of the duct within septum 8/9. The duct is not widened within the septum or parietes and there is no atrium.

Remarks.—The larger specimen with an ovisac extending into xx may be of adult size but the ovarian chamber and the ovisacs contain no free ova, indicating that sexual maturity has not been attained. Both testis sacs of the left side and the right posterior sac are dislocated to positions behind the ovarian chamber and median to the ovisacs. The absence of ovisacs, as well as the small size of the other reproductive organs, proves the juvenile condition of the second specimen.

The prostate is actually an elongate, hairpin loop of the vas deferens, the two limbs of the loop enclosed in a common sheath or sheaths, the ectal limb of the loop slightly thickened.

D. ferina is distinguished from *D. planata* Gates Gates 1931 by the absence of spermathecae in viii, from *D. doriae* Rosa 1890 by the location of the spermathecae in ix, and from *D. albalabia* Gates 1930 by the absence of spermathecae in viii and the erect prostates. In absence of clitellate individuals or specimens known to be fully adult a satisfactory diagnosis cannot be given.

Family GLOSSOSCOLECIDAE

Genus PONTOSCOLEX Schmarda 1861

Pontoscolex corethrurus (Fr. Müller) 1857

Material examined.—Manila, Philippine Islands, October, 13 juvenile and 14 clitellate specimens. Zacharias de Jesus per Prof. R. C. Osburn.

External characteristics.—The first setigerous segment is not recognizably marked off from a peristomium (which may be retracted) but is long and with the setae located nearer the posterior margin. In segmental enumerations the second setigerous segment is assumed to be iii. The anterior segments are strongly contracted so that nephropores are first visible on vi, and from there posteriorly about on *c*. The clitellum extends from an anterior portion of xv (9) or a posterior portion (5) onto xxiii (14).

Spermathecal pores are minute, in line with the nephropores, on 6/7-8/9 but are unrecognizable until after spermathecal ducts have been dissected out from the parietes. Female pores apparently are on 14/15, median to *a* but closer to *a* than to each other (1 specimen only). Male pores are unrecognizable.

Thickened "ridges" or "walls" are unrecognizable but on xix-xxii, on each side, just inside the median portion of *bc*, there is a clearly marked, slightly depressed, greyish translucent line with an appearance of a seminal groove, the line bent slightly mesially on the posterior half of xix and the anterior half of xxii so that the setal arcs of those segments are not quite reached (14).

Internal anatomy.—Septa apparently are lacking anterior to 5/6 (note location of nephridia of ii-v), 5/6 transparent and attached to the gut just in front of the gizzard; 6/7-9/10 funnel shaped, apices posteriorly; 9/10 displaced posteriorly and attached to the parietes directly over site of intersegmental furrow 10/11; 10/11-13/14 very delicate and displaced posteriorly.

The gizzard is in vi (14). Calciferous sacs are flattened, leaf-shaped bodies in vii-ix (14), the ducts passing to the gut dorsolaterally just in front of the septae. Intestinal origin probably in xiv or xv. The typhlosole begins abruptly in the region of xxv and is a simple lamella but with the height (2 mm.+) greater than the diameter of the gut so that the lamella is folded. The typhlosole ends abruptly 15-20 mm. from the hind end.

The dorsal blood vessel (single) is continued anteriorly to the pharyngeal region, deeply constricted behind 9/10 in such a way as to mark off eight to ten spheroidal sections, this portion of the trunk bent into an S-shaped figure and thus adding to the difficulties involved in determination of septal relationships. A supra-oesophageal trunk is recognizable only in x-xii or xiii. Extra-oesophageals are large in vi and filled with blood but elsewhere are empty, apparently passing ventrally on the anterior face of 5/6 and then turning mesially to unite under the gut. What appear to be posterior continuations of the trunks are close to or on the gut from vii posteriorly, in the region of ix-xiii at least, represented only by a median vessel on the ventral face of the gut. The subneural trunk is larger than the ventral vessel and looped with closed ends of the loops projecting out beyond the nerve cord. A pair of large branches in xii pass upwards to the supra-oesophageal but the trunk is continued anteriorly at least to 9/10. One or two other pairs of large vessels from the subneural have not been traced. In xii-xiii (?) four large vessels, apparently from the united extra-oesophageals, pass up from the gut to the supra-oesophageal. There are two pairs of hearts posterior to 9/10 (14) presumably

of x-xi, all of which open into the supra-oesophageal. Connections to the dorsal trunk not found.

From x forwards nephridia are on the anterior faces of the septa, nephridia of iii-v on the anterior face of 5/6 but identifiable by the ducts which pass forwards and into the body wall at the usual positions in iii-v. Nephridia of ii are represented apparently by a large cluster of tubules on each side filling the space in front of 5/6 between the gut and the body wall. In each cluster is a large duct with two long, hairpin loops, which then passes anteriorly close to the ventral parietes and about in region of ii upwards into the gut. Nephridial funnels in the postclitellar segments are preseptal, close to the ventral parietes median to *a*, markedly scoop-shaped, the back of the scoop continued into two prongs. Anteriorly funnels have not been found.

Testes and male funnels are in two fairly widely separated and longitudinally directed, suboesophageal testis sacs so placed that the ovaries are just beneath the posterior ends. The hearts of xi apparently are included within the testis sacs which are filled or nearly filled (when small amounts of coagulum are present) by large, accordion-pleated frills (peripheral portions of male funnels?). On the floor and at the center of the sac is a rounded, button-like structure with a central depression which is probably the aperture of the funnel. From a point just in front of this aperture the male deferent duct drops to the parietes and then passes laterally for a short distance before turning to run posteriorly in the median part of *bc*, visible as far back as xvi or xvii before passing out of sight in the parietes.

The ovaries are unusually small. The oviducal funnels are flattened and very thin discs rather high up on the anterior face of 13/14, the oviducts unusually long but passing straight anteroventrally along the septum to the parietes.

Remarks.—In spite of the ubiquity of this species in the tropics and the frequent reports of its occurrence several questions as to gross morphology are still unanswered. The major difficulty is that of determination of segmental location of structures and this is due in part to the apparent absence of the first intersegmental furrow, the small size of the setae on the first setigerous segment, the dislocation posteriorly of certain septa, the small size and concealed location of the ovaries. The location of septum 9/10 over site of intersegmental furrow 10/11 is at first confusing but inspection of the inner surface of the parietes reveals quite clearly two segments between the parietal attachments of the last muscular septum and of the septum next in front. This presumably is the explanation for Stephenson's failure to find 9/10 (1923, p. 490). However in front of the last muscular septum there is only one pair of nephridia and one pair of vascular commissures while the attachments to the gut of the last calciferous sacs, supposedly of ix, are just in front of the last muscular septum, conditions which arouse a suspicion that 9/10 is not lacking but merely displaced posteriorly. The suspicion is strengthened on tracing the ducts of the nephridia, for each duct after dropping to the ventral parietes passes across *two* segments almost to 8/9. The final confirmation of the dislocation of 9/10 is provided by the ducts of the nephridia next behind the last muscular septum, the ducts passing on the parietes and underneath 9/10 and onwards under very delicate connective tissue to points just behind the site of intersegmental furrow 9/10. According to Michaelsen (1900, p. 425) 10/11 is thickened but in each of the Manila specimens that septum is just as tenuous and transparent as those next behind.

Oviducts were noted in one specimen only and in that worm were large enough so that they could be dissected out from the body wall. Only then were the female pores recognizable. The location on 14/15 is unusual and may be an abnormality.

(The use of "apparently," or similar phraseology, in the account above is regretted but the word concisely characterizes appearances, and nothing further is justifiable in view of the condition.)

Septal relationships as regards segments x-xv, the segment of intestinal origin, some of the relationships of the major blood vessels and the location of the female pores need confirmation or more accurate characterization.

Genus SPARGANOPHILUS Benham 1892

Sparganophilus eiseni Smith 1895

Material examined.—Roadside ditch, Yellow Fern Creek, Fort Myers, Florida, January 21, 1941, 11 aclitellate specimens. Prof. W. M. Barrows.

Roadside ditch, Fort Myers, Florida, February 19, 1941, 11 aclitellate and 3 clitellate specimens. Prof. W. M. Barrows.

External characteristics.—Length 80–85 mm. (clitellate specimens). Diameter $1\frac{1}{2}$ mm. in clitellar region, $1\frac{1}{4}$ mm. elsewhere. Unpigmented. Anterior ends not hooked. Prostomium zygalobous (20). No dorsal pores recognizable but a longitudinal grey streak along the mid-dorsal line crosses i-iii to $3/4$ or slightly onto iv, the streak slightly widened at intersegmental furrows and there with an appearance somewhat like that of rudimentary dorsal pores. Setae begin on ii, dorsal couples lacking on xvi-xxiv (3 clitellate and 6 aclitellate specimens), in part lacking or unrecognizable on the same segments of several other specimens. Behind the clitellum *ab* is slightly smaller than *cd*, *dd* and *bc* about equal and both larger than *aa*. Nephropores are invisible but sites are indicated by tiny, white, circular spots on or slightly lateral to *a*, about midway between intersegmental furrows and setal arcs.

The clitellum is rather grey, saddle-shaped, lacking in *bb*, anterior and posterior limits unrecognizable externally, xvi-xxiv included (3) and part at least of xv (1) and xxv (2) or xxv-xxvi (1) as indicated by the epidermal thickening at the mid-dorsal incision. The clitellar region is protuberant especially so at xix-xxi. Tubercula pubertatis are represented by longitudinal white bands (not protuberant) extending from or just behind the setal arc of xviii to 23/24 in the median half of *bc*, the margins, especially the lateral, sinuous (3).

The spermathecal pores are on 6/7–8/9 on *c* (3), the left pore of 8/9 quite definitely below *c* on one specimen. Female pores are on xiv, on or just lateral to *a* and about midway between 13/14 and the setal arc. Male pores are unrecognizable. Apertures of the prostate-like glands are minute, on the ventral faces of tiny, nearly spheroidal, whitish protuberances located slightly posterolateral to the *b* setae of xvi-xvii and xxiv-xxvii (3 clitellate and several aclitellate specimens). On two of the clitellate specimens a circular area including the right *a* seta of ix is slightly tumescent but the only pore recognizable is the aperture of the setal follicle.

Internal anatomy.—No gizzard. An oesophageal valve is unrecognizable, the intestine apparently beginning with 8/9 or posteriorly in viii. No typhlosole.

The dorsal blood vessel (single) is continued anteriorly into ii, with moniliform hearts in vii-xi (7) and slender commissures in iii-vi. No subneural. Lateroparietal trunks are recognizable in vi-xiv, turning mesially just in front of 14/15, uniting on the upper surface of the ventral trunk and then disappearing from view (3, opening into ventral trunk?). On the parietes in xii-xiv just lateral to each lateroparietal trunk is a smaller vessel which turns upwards on the anterior face of 14/15 to open into the dorsal trunk.

Nephridia are present in xiii (14), lacking in xiv (14), present from xv posteriorly, the preseptal funnels close to the ventral parietes in *ab*.

Seminal vesicles of xi and xii are acinous with scattered brown flecks. The prostate-like glands of xxiv-xxvii are shortly and regularly looped in a rather zigzagged manner, the ducts straight, slender and with slight (muscular?) sheen. Glands in xvi-xvii usually are not looped but are arced. The gland of ix (right side only, two clitellate specimens) is fairly large and of irregular shape.

Remarks.—Spermathecae, present only in the clitellate specimens, appear to be juvenile, ampullae slightly developed in one worm only. There is no iridescence on male funnels or in the deferent ducts. Seminal vesicles and ovisacs are of about the same size and appearance in the clitellate and larger aclitellate specimens. In one of the clitellate worms the free extremity of one ovary passes through an aperture in 13/14 into the ovisac of the same side.

According to Hague (1923, p. 22) the prostate-like glands of *eiseni* usually open to the exterior through the follicles of the *b* setae, while in *benhami* Eisen 1896, according to Eisen, the apertures are anterior to *ab*. In the Fort Myers worms the pores are invariably posterolateral to *b*.

Hague has suppressed *benhami* with varieties *guatemalensis* and *carnea*. Possibly the taxonomy of the Sparganophilids of the United States requires reconsideration.

Family LUMBRICIDAE

Genus EISENIA Malmgren 1877

Eisenia foetida (Savigny) 1826

Material examined.—New Orleans, Louisiana, December 15, 1940, 2 clitellate specimens. E. Liebman.

Campus, Johns Hopkins University, October, 1940, 4 clitellate specimens. Per Prof. S. O. Mast.

November, 1940, 2 acitellate and 16 clitellate specimens (history unknown). Prof. W. M. Barrows.

Ohio division, California Earthworm Farms, Worthington, Ohio, January 10, 1941, 3 partially clitellate and 24 clitellate specimens. Per E. Gordon.

"Soilution earthworms," purchased from California Earthworm Farms, Los Angeles, California, December 30, 1940, 27 juvenile or acitellate (and in part postsexual) and 42 clitellate specimens. Per E. Hoffman.

External characteristics.—The Johns Hopkins worms are small, 27–30 mm. long, though apparently complete and fully grown. The "soilution" worms may attain a length of 60 mm. and a diameter of five mm. Except under the highest powers of the binocular, the Johns Hopkins worms appear to be characterized by a uniform, dark red pigmentation without striping. Only 13 of the "soilution" worms have a conspicuous striping, on the other specimens the striping faint or quite unrecognizable. The prostomium is epilobous, *ca.* $\frac{1}{2}$, a transverse furrow at the posterior end of the tongue usually lacking or if present slight and rather irregular. The first dorsal pore is on 4/5 (48), on 5/6 but with a definitely pore-like and possibly functional marking on 4/5 (3). Nephropores usually are unrecognizable but on several specimens pore-like markings are visible on xv and xvi halfway between *b* and mid *bc*.

The female pore is minute, on the setal arc of xiv, just lateral to *b*. The male pore is minute, on the setal arc of xv, about midway between *b* and *c*, often at the lateral end of a fairly deep, transverse slit with tumescent borders. Spermathecal pores are smaller than the male and female pores, on 9/10 and 10/11, slightly lateral to the mid-dorsal line. Pores may be symmetrically or asymmetrically placed with reference to the mid-dorsal line. If symmetrical, apertures of either pair may be slightly more widely separated than those of the other pair.

Clitellar margins (anterior, posterior and ventral) are often rather indistinct. Slight clitellar thickening of the epidermis anteriorly and posteriorly beyond the apparent (external) limits may be recognizable at the middorsal incision. The clitellum is located as follows: on xxv–xxxi (1), xxv–xxxii (1), xxvi–xxxi (9), xxvi–xxxii (52), xxvi–xxxii but reaching slightly onto xxv (1), xxvi–xxxii but reaching slightly onto xxxiii (3), xxvii–xxxii (4), xxvii–xxxiv (1).

Tubercula pubertatis are rather indistinct and boundaries are often difficult of recognition. Usually the tubercula appear to be of a rather narrowly elliptical outline and are longitudinally placed in the median half of *bc* with the median margins slightly lateral to *b*. A central portion, also of elliptical outline, is slightly more translucent than the rather wide, slightly tumescent and opaque, marginal portion. Tubercula pubertatis are located as follows: xxvii–xxx (1), xxviii–xxx (48), xxviii (postsetal half)–xxxii (presetal half)—23, xxviii (postsetal half)–xxxii (presetal half)—1, xxix–xxxi (3).

A variable number of the ventral setae in the clitellar region, and occasionally on one or two segments just in front of the clitellum, appear to be located each within an area of greyish translucence. Under highest powers of the binocular there is clearly recognizable just behind each of such setae a small, transversely placed, translucent marking of spindle or crescent shape. On such a marking there may be recognizable a single, minute spot with an appearance of a pore. If setae are carefully pulled out of the body wall from the interior after opening

the worm, the anterior location of the aperture of the setal follicle, quite definitely in front of the marking, is clearly recognizable.

Local areas of tumescence extending across the whole of certain segments may have somewhat of an appearance of genital markings but never seem to be sharply demarcated. These areas are most commonly present on ix-xii in region of *cd* but have been noted on ix (2), xxi (2), xxii (1), or xxiii (2), in *ab*. An area around the male pore and in a median portion of *bc* is usually more or less markedly tumescent but the swelling may be entirely lacking on fully clitellate specimens with spermatozoal iridescence in the spermathecal ampullae.

Flattened discs are occasionally adherent to the body in intersegmental grooves: 20/21, in *bc* (1); 21/22, in *aa* (2), in *ab* (2), in *bc* (4); 22/23, in *aa* (1), in *bc* (4); 23/24, in *aa* (2), in *bc* (1); 24/25, in *aa* (1), in *bc* (1). The outline of the disc approximates to circular or pear-shaped. The peripheral portion is transparent, a central mass opaque and with an appearance of closely packed fibrils.

Internal anatomy.—There are no sacs on the oesophagus in x (20). Calciferous glands are in xi-xii. On each side of the oesophagus in xii there is a vertically placed, rather shortly hemi-ellipsoidal, white swelling, the white appearance due to presence in the calciferous glands of considerable masses of fine granules. The intestine begins in xv (20). The gizzard is located in xvii-xviii (20). The wall of the gut in xix is usually whitened and similar in superficial appearance to the gizzard.

The simple, lamellar typhlosome which begins gradually in the region of xx-xxiii, does not attain full height for several segments and ends abruptly, in lxxxix (worm of 100 segments), xcii (worm with 103 segments), or ciii (specimen with 117 segments). The lumen is vertically slit-like in cross section. In one or more small regions or along a considerable portion the ventral margin may be slightly furrowed longitudinally so that the typhlosolar lumen is rather Y-shaped (inverted) in cross section.

Five pairs of lateral hearts are present in vii-xi (20). In xii, opening into the dorsal trunk, there are two pairs of vessels which may be large, the posterior vessels resembling hearts but closely applied to the gut and gradually disappearing from view ventrally. A subneural trunk is present (20).

Seminal vesicles are four pairs, in ix-xii (20), those in ix-x usually about half the size of the others. Segments x-xi are usually filled with a testicular coagulum.

Spermathecal ampullae are usually in ix and x (19). In one specimen an ampulla is sharply constricted by 10/11, with one half each in x and xi. In another worm the left anterior ampulla is in x. One spermatheca is completely bifurcated entally, each ampulla containing a mass of spermatozoa.

Corresponding to each of the small, postsetal genital markings and closely associated with a setal follicle there is protuberant into the coelomic cavity from the parietes a soft gland so fragile that it usually fragments on manipulation, releasing a flocculent coagulum.

Remarks.—In one worm each seminal vesicle of ix-xii contains masses of brownish material similar to that forming the discs often present in the coelomic cavities. Another specimen has brownish material in the vesicles of xi and xii and several brown bodies or discs free in the coelomic cavity of xi.

Eisenia veneta (Rosa) 1896

F. hortensis Michaelsen 1890

Material examined.—"Found in toilet bowl," Cleveland, Ohio, April, 1941, 1 clitellate specimen. E. R. Miller per Prof. W. M. Barrows.

External characteristics.—Length 23 mm. Diameter 3 mm. Dorsum reddish anterior to clitellum. Behind the clitellum the body is markedly flattened dorsoventrally. Prostomium apparently prololobous but this appearance may be due to local contraction at the region of junction of prostomium and i. The first dorsal pore is on 5/6. Setae begin on ii, behind the clitellum *ab* and *cd* about equal though rather widely separated, *bc* < *aa*, *dd* < $\frac{1}{2}$ C.

The protuberant clitellum extends from 26/27 to 32/33 laterally but dorsally xxxiii is included (*dd* only), the anterior and posterior limits sharply marked, the ventral boundary hardly recognizable. Tubercula pubertatis are on xxx-xxxi and the presetal portion of xxxii, well within median half of *bc* and reaching slightly into *ab* with *b* included and near the median margin, sharply demarcated, protuberant—especially so laterally, the margins slightly incised at 30/31 and perhaps indicating a double origin.

Spermathecal pores are on 9/10 and 10/11, slightly lateral to the mid-dorsal line. Female pores are on the setal arc of xiv slightly lateral to *b*. Male pores are in transversely slit-like depressions on the setal arc of xv and are quite definitely nearer to *b* than to *c*.

Internal anatomy.—The oesophagus is widened abruptly in the posterior portion of x but no sacs are recognizable. Longitudinal lamellae in xi-xiii are covered over mesially by a delicate and transparent film possibly representing the median wall of calciferous glands. The intestine begins in xv. The gizzard is in xvii-xviii. The typhlosole which begins in xx is low and of the simple, lamellar type. Last hearts in xi.

Male funnels are large, reaching to the level of the dorsal surface of the gut, and with a brilliant spermatozoal iridescence. In addition to the usual seminal vesicles in xi and xii there is a single, smaller vesicle in ix on the left side. Spermathecae are in ix and x, the ampullae filled with iridescent material, slender ducts and ampullae of about the same length.

Protuberant into the coelomic cavities from the parietes over the tubercula pubertatis are glandular masses just median to which are hypertrophied follicles of the *b* setae of xxx and xxxi. The setae are nearly straight, without nodulus, the extreme ental end portions slightly curved, the tips sharply pointed, an ectal portion grooved. No ornamentation.

Remarks.—The gut is somewhat macerated. In the intestine among the soil particles is a well rounded, almost spheroidal bit of quartz just over one mm. in diameter.

E. veneta is a European form and has been recorded but twice before from North America: San Francisco and Urbana, Illinois. Smith (1924, p. 26) found it in large numbers in banks of streams and it is presumably from some such habitat that the Cleveland specimen got into the water supply.

Genus BIMASTOS Moore 1893

Bimastos tenuis (Eisen) 1874

Material examined.—Sand pasture, Manitoulin Island, Ontario, August 13, 1940, 1 acitellate and 2 clitellate specimens. C. H. Kennedy per Prof. R. C. Osburn.

External characteristics.—Length 20-27 mm. Diameter across clitellum, three mm. The dorsum anterior to the clitellum is red. Setae *a* and *b* of xvi are enlarged, the follicles conspicuously protuberant into the coelomic cavity just behind a glandular mass. All of the setae examined, except one, are sigmoid but with the nodulus about one third the distance of the shaft from the ental end. The exceptional seta is almost straight, no ornamentation recognizable.

Spermathecal apertures are minute openings on 9/10, on *c*. The female pores are very slightly posterolateral to *b*. Each male pore is within and close to the lateral margin of a transversely placed, slit-like depression located in an area of tumescence. A transversely placed area on xv and xvi just lateral to *b* is swollen and whitened but without distinct demarcation.

Tubercula pubertatis are small, slightly tumescent, whitened areas of approximately circular outline, with centers about on the *b* line and reaching slightly into *ab*, the *b* setae of xxix and xxx very slightly displaced mesially.

Internal anatomy.—Calciferous pouches are vertically ellipsoidal bodies in the posterior portion of x, clearly marked off from the gut but without stalks, opening into the gut through vertically slit-like apertures the margins of which are in apposition. A low typhlosole is present.

The male deferent ducts of a side pass laterally to the region of *c* and come into contact in xii, passing posteriorly on the parietes to the anterolateral corner of a flat glandular mass with a longitudinally rectangular outline, sessile on the parietes in xiv-xvi, in a median portion of *bc*. Other glandular masses of approximately circular outline are sessile on the parietes over the tubercula pubertatis.

Spermathecae have a spheroidal ampulla and a slender duct with the length about equal to the diameter of the ampulla.

Remarks.—Specimens are too soft to permit determination of typhlosolar characteristics. Calciferous sacs of *x* are filled with clumps of white granules. Because of the stickiness of the glandular material the course of the male deferent ducts has not been completely traced but it appears to be posteromesially within the gland. Ducts are slightly iridescent, fairly large, on rather than within the parietes and hence easy to trace. Removal of nephridia is necessary for observation of the genital marking glands and enlarged setal follicles. One specimen has a single spermatheca on the left side, another worm has a pair.

A non-sexual worm collected along the Chesapeake and Ohio Canal near the District of Columbia line by Slatin and forwarded by the U. S. National Museum may be *tenuis*. There are only two pairs of seminal vesicles and spermathecae are lacking. The region of xxvi-xxxi is contracted in a regularly concave fashion and has an appearance like that of a clitellar region towards the end of clitellar regression. The digestive system is macerated, the oesophageal wall practically transparent. In xi-xiii there are clearly recognizable, without opening the gut, two series of thin but rather conspicuous lamellae. Each lamella of the first series is longitudinally rectangular in shape, extending through xi-xii without constriction. Lamellae of the second series are almost square and in xiii, separated from the anterior series by an interval in which lamella are quite lacking. Lamellae are discrete and without evidence of marginal fusion internally (*i. e.*, towards center of gut). This condition (of discrete lamellae) presumably is a result of maceration.